Microsurgical Treatment of Unruptured Intracranial Aneurysms

A Consecutive Surgical Experience of 550 Cases in the Endovascular Era

THE NATIONAL BRAIN ANEURYSM CENTER

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Abstract

Introduction

As a result of improving endovascular techniques and the findings of the ISAT and ISUIA trials, progressively fewer intracranial aneurysms (IAs) are being treated with open microsurgery. There is limited information regarding the impact of this trend on the ability of younger neurosurgeons to achieve and maintain proficiency in the surgical management of IAs. We describe a consecutive series of patients with unruptured IAs treated by a neurosurgeon initiating a cerebrovascular practice in the "endovascular era." Prior to treatment, all patients were evaluated using a team approach to determine management recommendations.

Methods

We retrospectively reviewed the records of all patients who underwent surgical repair of a saccular IA by a single neurosurgeon from the time of completion of neurosurgical training in July, 1997 until January, 2006. Ruptured IAs were excluded from review.

Results

Of 1,500 patients with IAs treated during this period, 428 patients underwent microsurgical repair of 550 unruptured IAs. Aneurysm neck clipping was possible in most cases, although distal revascularization with proximal occlusion or trapping was employed in many of the more complex aneurysms. Major complications occurred in six patients (1.4%), and one patient died (0.23%). At six-month follow-up, four patients (0.93%) were left with a new neurological deficit related to surgery.

Conclusions

Despite the growing role of endovascular therapy in the management of IAs, it is possible for the young neurovascular surgeon to achieve acceptable results with open microsurgery for IAs. A close collaborative approach with endovascular colleagues, careful surgical judgment, and the early support of experienced mentors were considered essential in achieving success in this contemporary series.

Introduction

Over the past decade, several major factors have reduced the number of intracranial aneurysms (IAs) undergoing open microsurgical repair. The progressive refinement of endovascular techniques (balloon-assisted and stent-supported coiling) has substantially increased the percentage of aneurysms treated with coil embolization rather than open surgery (1,5). The ISAT trial suggested that endovascular therapy may be associated with a lower morbidity than open surgery after SAH, and the ISUIA trial suggested that smaller, unruptured aneurysms appear to carry a more benign natural history than previously appreciated, further tempering enthusiasm for open microsurgery in this setting (3,6). As fewer surgeons perform fewer open microsurgical procedures for IAs, general competence and comfort levels with this operation decline. It is difficult to assess the subtle but definite impact this trend has had and will have on the ability of younger neurosurgeons to become proficient in the surgical management of IAs.

Methods and Materials

From July, 1997 until January, 2006, our neurovascular service treated a total of 1,500 patients with IAs. During that period, a single neurosurgeon (ESN) repaired 550 unruptured IAs in 428 patients. There were 172 men and 256 women. Ages ranged from 22 to 84 years. A total of 305 patients had a single aneurysm, 123 had multiple lesions. Only patients with saccular IAs treated in the absence of acute SAH were included in this study. The majority were identified incidentally. Fifty-four patients had suffered a remote SAH from another previously treated aneurysm, and 30 patients presented with mass effect resulting in either cranial neuropathy or cerebral dysfunction.

Neuroimaging studies, inpatient charts, operative reports and drawings, and follow-up clinic notes were available in each case. All patients in this series underwent intraoperative angiography. One-month follow-up was available for all patients; six-month follow-up was available for 97% of patients and for all patients who suffered an early complication. Outcome was graded based on the Glasgow Outcome Scale (GOS), SF-12, and SF-36.

Results

There were 403 small (73%), 108 large (20%), and 39 giant (7%) lesions. Aneurysm locations and sizes are summarized in Table 1. Microsurgical neck clipping was achieved in 471 cases (86%). Forty patients underwent distal revascularization with proximal occlusion. Bipolar electrocoagulation with gauze reinforcement was utilized in the treatment of 29 microaneurysms, and 10 patients underwent gauze wrapping as primary treatment. Thirty-two aneurysms were clipped after having been previously coiled, and nine patients underwent clipping of previously operated aneurysms. Four patients underwent intentional subtotal clipping followed by subsequent endovascular coil obliteration of the residual aneurysm.

Major non-fatal surgical complications occurred in six patients (1.40%) - Table 2. Major complications developed in three small (0.74%), one large (0.93%), and two giant (5.13%) aneurysms. At six-month follow-up, four patients (0.93%) were left with a new focal neurological deficit related to surgery. The mortality rate was 0.23% (one patient). Symptomatic ischemic injury occurred in three patients (0.70%). In the absence of a new neurological deficit, we did not perform routine postoperative CT or MR imaging; therefore, we cannot comment on the incidence of silent ischemic injury in our series. Three patients suffered complications presumably related to direct surgical trauma. Additional complications included: delayed wound infection (1), lower extremity DVT (3), delayed chronic subdural hematoma (2), perioperative seizure (2), and third nerve palsy not present preoperatively (7). To date, no patient has experienced SAH following surgical treatment of their aneurysm with follow-up ranging from six months to seven years.

Patient evaluation using the SF-12 and SF-36 identified nine patients who would have been graded as normal (GOS=1) on the Glasgow Outcome Scale but who felt their quality of life was worse postoperatively. This was a heterogeneous group of patients who complained of a combination of postoperative problems including: headaches, anxiety regarding potential aneurysm recurrence despite reassurance, and attention difficulty interfering with job performance or social activities. In all cases, these 11 patients felt they were able to return to work or to their previous lifestyle "with minor modifications." Interestingly, there was no relationship between this finding of "mild" postoperative difficulty and aneurysm size, location, or patient age.

Table 1. Aneurysm Locations and size Distribution

Aneurysm Location	Small	Large	Giant	Total
All	**403**	**108**	**3739**	**550**
Internal Carotid	*139*	*37*	*17*	*193*
Petrous/Cavernous	0	1	3	4
Paracliniod	38	18	8	64
PCOMMA/AchA	77	13	5	95
Carotid Bifurcation	24	5	1	30
Anterior Cerebral Artery	*77*	*32*	*2*	*111*
ACOMMA	57	32	1	90
Distal Anterior Cerebral	15	-	1	16
A1 Segment	5	-	-	5
Middle Cerebral Artery	*164*	*31*	*15*	*20*
MCA Bifurcation	145	24	12	181
M1 Segment	17	4	2	23
Distal MCA	2	3	1	6
VertebroBasilar	*23*	*8*	*5*	*36*
PICA	10	1	4	15
Basilar Apex	13	6	1	20
Basilar Trunk	-	1	-	1

* PCOMMA– Posterior communicating artery, AchA– anterior choroidal artery, ACOMMA– Anterior communicating artery, MCA– Middle cerebral artery, PICA– Posterior inferior cerebellar artery

Table 2. Serious Complications and Associated Outcomes in 550 Unruptured Aneurysms

Age/Sex	Location	Size	Complication	GOS*
59/F	MCA	18mm	Perforator injury, Hemiparese (severe)	2
41/F	Basilar apex	8mm	Perforator injury Hemiparesis (mild)	1
65/F	MCA	4.8cm	Posterior dividion MCA infarct, SVG thrombosis	3
51/F	MCA	7mm	Retraction injury, transient dysphasia	1
68/F	Paracliniod	8mm	Subfrontal contusion	2
58/F	Paracliniod	4.2cm	Severe visual impairment	3
44/F	ACoA	6mm	Systemic thromboemboli	5 (Dead)

* GOS measured at six-month post-operative follow-up

Discussion

The appropriate management of unruptured IAs remains controversial. Although it appears that these lesions don't bleed often, when they do, the consequences are severe and potentially life-threatening (7,8). Although earlier reports advocated treating most unruptured IAs, some more recent studies have recommended treating only larger or symptomatic aneurysms because of their more aggressive natural history (2,4,9). Nevertheless, multiple investigators have described the rupture of small, asymptomatic, previously unruptured IAs that were being followed without treatment (7,10). Clearly, unruptured IAs should be treated only if surgical and endovascular complication rates can be kept at very low levels. Because these numbers may vary significantly based on surgical experience and treatment volume, it becomes critical for individual surgeons and centers to track their personal outcomes in these cases. In our experience, a collaborative team approach is critical in the management of unruptured IAs. By viewing open microsurgery and endovascular therapy as complimentary rather than competitive, each patient is offered the option that the team feels will have the highest likelihood of yielding the optimal result, balancing morbidity with durability of repair. Although the superior durability of microsurgical clipping as opposed to coiling is an important consideration, there is little benefit to the patient of leaving the operating room with a well-clipped aneurysm if the cost is a permanent disabling deficit that could have been avoided by an alternative treatment option. In the setting of unruptured IAs, we have generally recommended open surgery only when we feel confident that our surgical risk is extremely low. When it has been our impression that an aneurysm should be treated but the surgical risk in our hands is unacceptably high, we typically recommend endovascular therapy or referral to a center with greater expertise.

Conclusions

We present a large consecutive series of patients with unruptured IAs treated by a single neurosurgeon. The acceptable results in regard to morbidity and mortality in this complex group of patients support the idea that a young neurosurgeon can become proficient in the surgical management of even very complicated intracranial aneurysms despite the decreasing percentage of aneurysms that are being treated with open surgery. Of equal importance, it appears that this proficiency can be achieved without putting patients at undue risk by exercising careful surgical judgment. It is suggested that younger neurosurgeons who wish to manage intracranial aneurysms will have to work closely with endovascular colleagues and experienced surgical mentors and should demonstrate a dedicated interest in this area in order to treat an adequate volume of patients and ascend the learning curve over a reasonable period of time.

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